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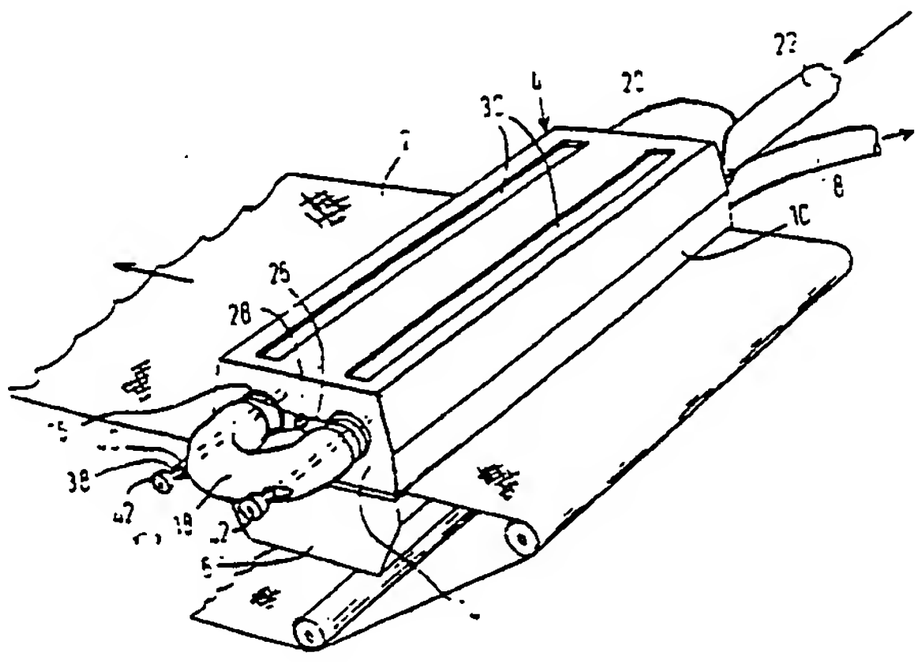
(54) A system for dry forming of paper or other sheet material of particles or fibres.

(57) For distributing loose fibres on a moving forming web (2) in dry forming of paper an air fluidized fibre material is fed to and recirculated in a pipe circuit comprising two parallel, straight screen pipes (12) extending over the forming web (2) and provided with interior, rotating needle cylinders (34) operating to both convey the material axially in the pipe and effect disintegration of the material as well as to add to the material flow a radial component promoting the fibre outlet through the walls of the screen pipes (12). These pipes (12) themselves are rotatably mounted and adjacent an upper outside area of each pipe (12) is arranged a stationary nozzle system (44) for blowing compressed air against the pipe to thereby successively clean the screen perforations for maintaining a high distributor capacity and enable relatively long fibres to be used in the production.



EP 0 032 772 A1

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A system for dry forming of paper or other sheet material of particles or fibres.

The present invention relates to a system for dry forming of paper or other sheet materials of particles or fibres and of the kind specified in the introductory clause of claim 1. A system of this kind is known from the USA Patent Specification No. 4,157,724, in which the distributor unit comprises an upwardly open container having lower side wall portions of a classification screen material which enables the fibre material in the container to be gradually let out through these wall portions, the outlet material then being moved down to the top surface of the moving, foraminous forming web by the downwardly directed air flow as caused by the suction means underneath the forming web. Inside the distributor container is mounted a row of impellers, the rotating wings of which serve to whip the fibre material in a recirculating flow one way along one side of the container and the opposite way along the opposite side. The impeller wings also impart to the material flow a movement component outwardly towards the insides of the screen walls, whereby the material flow is generally held against the respective walls, even through these project in a straight manner across the forming web, and by the same action the material output through the screen walls is generally promoted such that a high distributing capacity is achieved.

The said recirculation of the material in the container is highly advantageous partly as a means for providing an even distribution of the material inside the container, even if new

material is supplied at one place only, and partly because the material flow as generally passing across the forming web will prevent the formation of stripes in the fibre web as deposited on the moving forming web; in other known systems, in which the material in the container is not moved crosswise of the forming web, fibre lumps in the material or other local irregulatities may give rise to stripe formation, because they form local obstructions to a free fibre outlet and assume stationary positions as seen in the transverse direction of the fibre web being formed.

The recirculation of the material along the sides of the container requires a considerable driving effect of the said impellers, though in the known system this is to some degree justified by the fact that the said whipping wings serve not only to effect the recirculation, but also to whip the material for keeping it air fluidized, to increase the distributor capacity by forcing material out through the classification screens, and to generally hold the material flow against the inside of the screens, such that it maintains its character of a well defined and confined flow, without individual fibres spreading all over the container space and depositing themselves whereever possible. But still, the impellers should be driven with considerable power for producing the desired effects, and besides it can be operationally inconvenient that the single parameter constituted by the speed of rotation of the whipping wings will thus determine several different functions of the distributor in an interrelated manner.

It is the purpose of the invention to pro-

vide a dry forming system of the kind referred to, which is of a simple disign essentially different from that of the known system, and which is usable or operable in a more flexible manner.

According to the invention the outlet wall portion forms at least a part of a pipe which is used for guiding the flow of material along the respective length or partial length of the recirculation path, the latter preferably being located entirely within a closed pipe circuit.

The technical main effect of the invention is that the recirculation flow of the material may be supported or maintained merely by way of transportation air through the said pipe, because there is no longer any need to arrange for the material flow to be held monolaterally against a guiding wall. The flow will be effectively confined by the pipe, and basically the recirculation movement as such will then be produceable by simple blower means in a very economical manner.

It will still be possible to arrange for special means inside the pipe for causing the fibre material to be kept air fludized and to be urged against the inside of the screen wall portion, i.e. the corresponding operational features of the known system will be retained, but now without necessarily having to be interrelated in any fixed manner, neither mutually nor with the recirculation velocity.

In a preferred embodiment, however, use is made of a rotating needle cylinder extending axially through the respective straight pipe lengths, this cylinder operating both to contribute to the recirculation flow, to effect

air fludization of the fibre material in the flow as well as even to effect disintegration of fibre lumps, and to cause a general outthrowing action on the material in the flow. Then these functions, of course, will be interrelated, but it is still possible to adjust the recirculation velocity in an independent manner, by varying the supply of additional transportation air or provide for a throttling somewhere in the pipe circuit.

When the pipe system is entirely closed, of course exept for the perforations and the material inlet, a further adjustable parameter will be the general internal pressure of the pipe system.

In a very important embodiment of the invention the screen wall portions of the pipes crossing the forming web are extended to simply constitute the pipes entirely, i.e. all the way round, and these pipes or pipe portions are arranged so as to be rotating during the operation. As air is drawn down through the horizontal perforated pipe, the fibres will leave the pipe through the lower portion thereof, and a tendency will exist to fibres sticking to the edge portions of the perforations, whereby the free area thereof may become reduced. However, when the pipe is rotating, even at slow speed, the same perforations will soon be located adjacent the top side of the pipe, and here the downwardly directed air flow will penetrate the perforations with opposite relative direction, whereby the perforations will be cleaned in a successive manner. Topwise of the pipe may even be arranged for special cleaning means such as air nozzles blowing compressed air against a restricted area of the outside of the pipe, whereby the perforations and the outside of the pipe may be cleaned most effectively.

It has been observed that the cleaning here discussed has a remarkable influence on the entire system not only because the screen perforations are

kept open to maintain a high capacity of the system, but also because the system as here described is able to handle a fibre material, in which the length of the fibres may substantially exceed the fibre lengths which have until now been considered as a maximum in connection with dry forming processes. Thus, a conventional fibre length maximum is some 3-4 mm, while experiments have shown that a system according to the embodiment of the invention as here discussed can easily handle a material in which the fibre length is some 20-25 mm, perhaps even higher.

Thus, the general concept of enclosing the recirculated material flow in a pipe system at least along the more relevant portions of the entire circuit is indeed conditioning an important row of advantages as seen in the various aspects of the invention.

In the following the invention is described in more detail with reference to the accompanying drawing, in which:-

Fig. 1 is a perspective view of a system according to the invention,

Fig. 2 is a cross sectional view thereof,

Fig. 3 is a plan side view, partly in section, and

Fig. 4 is a cross sectional view of a modified detail.

The system shown in Figs. 1-3 comprises a foramious forming web 2 which is moved continually through a closed path (not shown in full) so as to pass underneath a distributor unit 4. Underneath this unit and the web 2 is mounted a suction box 6 having an exhaust pipe 8 connected to a suitable suction blower. The distributor unit 4 comprises an outer housing 10, which is open downwardly towards the web 2, and two horizontal pipes 12 extending through the housing across the web, these pipes being made of classification screen material, i.e. a net material or perforated sheet material. The end portions of the pipes 12 are supported by rotat-

ion bearings 16 mounted in the opposed end walls 14 of the housing 10, and outside the walls 14 the respective pipe ends are interconnected through exterior, stationary U-pipes 18 and 20, of which the U-pipe 20 is provided with a tangential inlet pipe 22 projecting in line with one of the pipes 12. The end portions of the pipes 12 are provided with non-perforated sleeves 24 cooperating with the bearings 16 and received in a sealed, rotary manner in or by the ends of the U-pipes 18 and 20.

Adjacent at least one end of the pipes 12 the sleeves 24 cooperate with driving means for rotating the pipes 12,24, e.g. as shown in fig. 1 a driving belt 26 driven by a motor pulley 28.

The top side of the housing 10 is provided with slot openings 30, which may be width adjustable by means of valve plates 32.

The system already as described so far may be operative in the manner that a flow of air fluidized fibre material is supplied through the tangential inlet pipe 22 from a blower (not shown), whereby is created a recirculating material flow in the pipe system 12, 18, 20. From this flow individual fibres will be let our through the screen pipe walls together with the surplus of transportation air as supplied through the inlet pipe 22. From the suction box 6 air is sucked down through the foraminous forming web 2 and down through the housing 10 from the upper slots 30. This generally vertical air flow will pass both across the screen pipes and along the outsides thereof thus promoting the outlet of fibres from the pipes and conveying the outlet material down to be deposited on the forming web 2.

The air as drawn downwardly from the upper slots 30 will show the additional effect that it serves to successively

clean the outside and the perforations of the screen pipes as these are rotated, such that fibre material deposited adjacent and inside the perforations in the lower outlet portion of the pipes will now be removed by the "counterflow" action of the downflowing air. Possible fibre collections on the outside of the pipes may be blown off when they pass through the upper path of rotation of the pipes, whereby is prevented the formation of lumps which are otherwise liable to occur on the outside of the classification screen, e.g. due to static electricity; it is well known that such lumps are disadvantageous, because after growing to a considerable size thet will fall off and be deposited on the forming web.

The cleaning of the perforations and the outside of the screen pipes 12 may be substantially amplified by means of additional exterior cleaning means such as a rotary brush or - as shown in fig. 2 - a nozzle system 44 on a pipe 46 connected to a source of compressed air, whereby air jets are blown against the outside of the pipes 12 either continually or intermittently. In this way a very efficient cleaning is obtainable, and as a result it will be possible to handle fibres of a considerable length and with a durably high capacity of the system.

In a large scale production system the mere recirculation of the material through the pipes by virtue of the air supply through the pipe 22 may be insufficient for ensuring that the material is kept properly air fluidized. Therefore, in each pipe 12 is arranged an axially oriented agitation cylinder 34 provided with radial agitation needles 36 all along the length thereof, the cylinders having shaft portions 38 mounted in bearings 40, these shafts at least at one end being extended outwardly and provided with pulleys 42 or similar means enabling the

cylinders 34 to be rotated relatively fast by suitable driving means (not shown).

Preferably the external diameter of the needle cylinders 34, 36 is pronounced smaller than the internal diameter of the pipes 12, and the cylinders are mounted eccentrically such that the needles 36 sweep closely over the lower inside portion of the screen pipe 12. Hereby the needle tips will brush off any possible fibre collections at the inside of the pipe, and moreover the needles will show a pronounced desintegrating effect on the material, should the same contain fibre lumps.

Furthermore the needles 36 will act to directly throw material out through the screen, such that a very high outlet capacity can be achieved.

As shown in Fig. 3 the needles 36 are mounted on the cylinder with small mutual distance along a screw line on the surface thereof, and during their rapid rotation the needles will thus act as a conveyor worm, which will promote the general material flow through the pipe 12. The recirculation flow may well be produced by conventional blower means, e.g. axial blower wings mounted direct on the cylinders near the ends thereof. Another possibility is to cause transportation air to be injected into the system through nozzles located inside the U-pipes 18 and/or 20. However, it seems to be fully sufficient to use the cylinders 34 for this purpose, when the needles 36 are arranged along a screw line. Of course, the needles or some of them may be shaped slightly propeller formed for extra contribution to the main flow.

Inside the pipes 12, adjacent their top side, may be arranged a stationary shield plate 48 supported endwise by means of brackets (not shown) inside the U-pipes 18 and 20. This plate serves to limit the direct downflow of air through the screen pipes to the forming web 2,

as it may be desirable to effect an increase of the air flow down along the outsides of the screen pipes. However, air from above can still enter the screen pipes through the side portions thereof.

The needle cylinder 34,36 shows a remarkable desintegration effect on fibre lumps, perhaps due to its eccentric location in the pipe 12, and in an extreme case it could be possible to supply the material to the pipe system solely as fibre lump material e.g. injected through a top or inner side opening in one of the U-pipes 18,20. The supply pipe 22 may then be avoided or used solely for supply of extra air.

In Fig. 4 it is illustrated that in stead of a needle cylinder in the screen pipes it is possible to use one or more throughgoing pipes 50 connected to a source of compressed air and provided with nozzle means 52 for directing an air jet towards the inside of the screen pipe, whereby an outthrowing and agitating effect on the fibre material is obtained. The jets may have a velocity component downstream in the pipe.

The flow and pressure conditions inside the pipes 12 will vary somewhat along the length thereof, and if neccessary it will be possible to cause some differentiation of these conditions, e.g. by arranging for the top shield plate 48 to be axially inclined or to have varying width along the pipe. The screw line of the needles 36 along the cylinder 34 may show a non-constant pitch, and the degree of perforation of the screen pipes may be graduated.

It would be possible to make use of only one screen pipe 12, when the remaining pipe system is non-perforated; however, the pronounced movement of the material inside the pipe may tend to effect a varying outlet capacity along the pipe, and for obtaining an even fibre distribution in the web to be produced it will normally be recommendable to use the scfeen pipes 12 pairwise, since the return

flow through the other screen pipe may compensate for a non-uniform capacity of a single pipe. On the other hand the recirculation system may well comprise more than two screen pipes 12, for instance four such pipes.

The rotation of the screen pipes, which is very important for the said cleaning of the perforations, may well take place at such speed that the associated centrifugal forces hereby contribute to increase the outthrowing effect on the fibres located in or adjacent the perforations.

The invention also comprises the described method of producing a web material by guiding a material flow through distributor pipes 12 and preferably rotating the pipes during the operation and cleaning them in a successive manner during the rotation.

CLAIMS:

1. A system for dry forming of paper or other web material of particles or fibres, comprising a moving foraminous forming web (2) and a distributor unit (4) placed thereabove as a container provided with a perforated outlet wall portion, through which a particle or fibre material supplied to the container can gradually leave the container, suction means (6) being arranged underneath the foraminous web (2) for sucking air down through this web to convey the outlet material to be deposited onto the web, said distributor unit being of the type having means for guiding the material supplied thereto in an air flow through a recirculation path , of which at least a partial length extends over the foraminous web (2) along the interior side of said outlet wall portion of the container, characterized in that the outlet wall portion forms at least a part of a pipe (12) used for guiding the flow of material along the respective length or partial length of the recirculation path, the latter preferably being housed entirely within a closed pipe circuit (12,18,20).

2. A system according to claim 1, characterized in that said pipe (12) is rotatably arranged, and that substantially stationary screen cleaning means such as air nozzles (44) are provided for cleaning the perforations from outside the pipe.

3. A system according to claim 2, characterized in that the screen pipe (12) is made entirely of classification screen material and is arranged for continuous or intermittent one-way rotation.

4. A system according to claim 1, 2 or 3, characterized in that there is arranged, inside the screen pipe (12), separate or combined means for agitating, desintegrating, outthrowing, and/or axially conveying the material in the pipe (12).

5. A system according to claim 4, characterized in that said means comprise a rotating needle cylinder (34,36) preferably mounted eccentrically in the pipe.

6. A System according to claim 5, characterized in that the needles (36) are arranged along a screw line on the cylinder.

7. A system according to claim 4, characterized in that said means comprise a system of air nozzles (52) mounted on stationary carrier means (50) and blowing an air jet against the inside of the screen pipe (12).

8. A system according to claim 3, characterized in that a shield plate means (48) is mounted stationarily inside the screen pipe (12) adjacent the top portion thereof.

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FIG.1

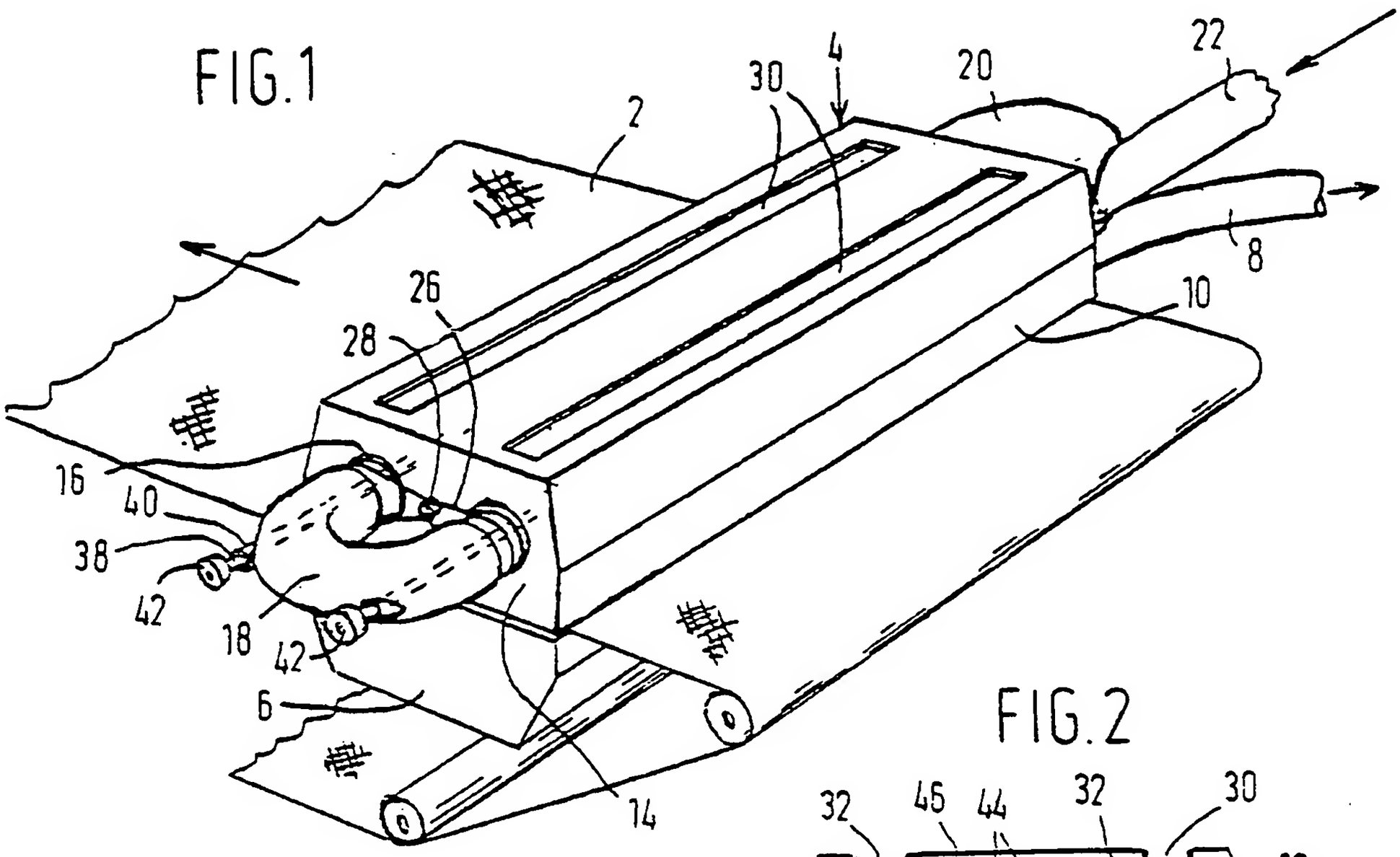


FIG.2

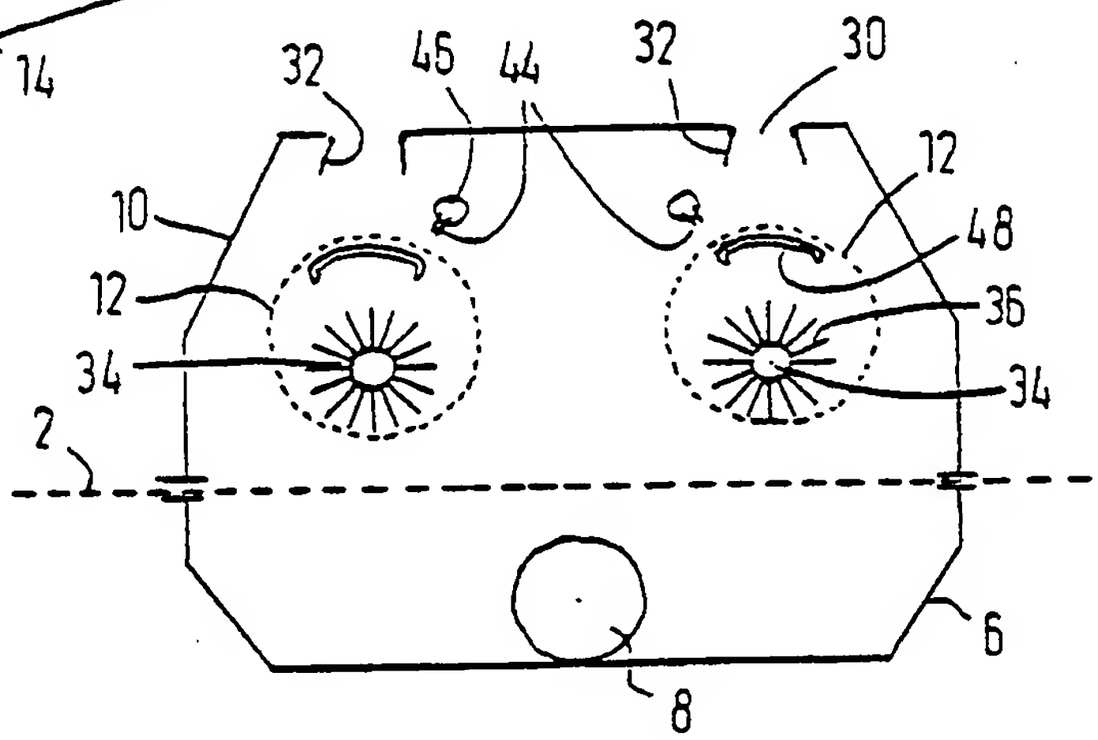


FIG.4

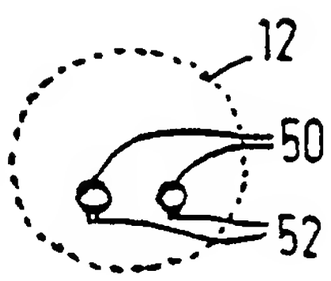
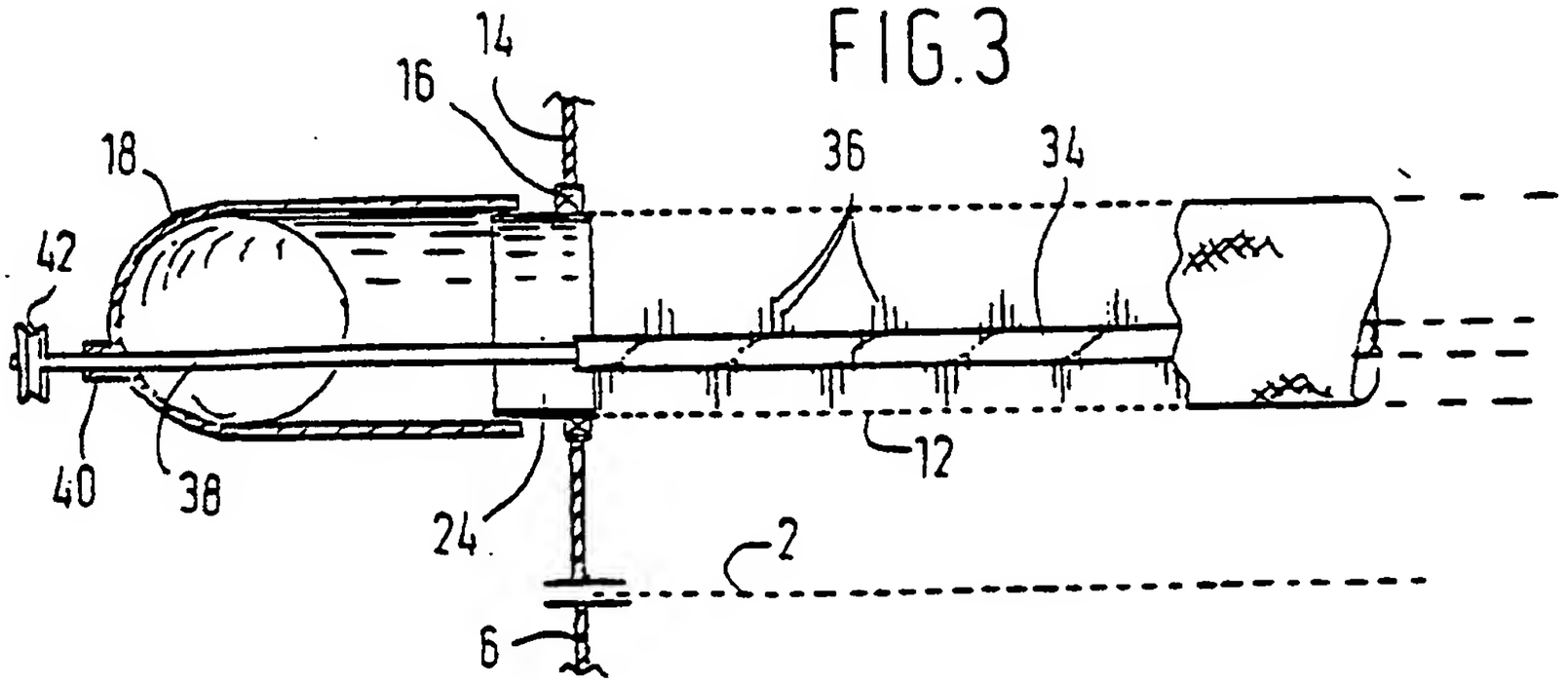


FIG.3



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EUROPEAN SEARCH REPORT

Application number
0032772
EP 81 20 0058

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl.³)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	D 21 H 5/26
A	FR - A - 2 305 537 (RIEGEL TEXTILE) * Claims 1 and 2 and figures 1-3 * & US - A - 3 857 657 ---------	1	TECHNICAL FIELDS SEARCHED (Int. Cl.³) D 21 H 5/26

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	06.04.1981	ELSEN-DROUOT

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